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| 10/057,179 | 01/25/2002 | Xiaoqiang Ma | MH-5091 | 5294 |

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Patent Department
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| EXAMINER | |
|---|---|
| PERILLA, JASON M | |

| ART UNIT | PAPER NUMBER |
|---|---|
| 2638 | |

DATE MAILED: 07/12/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

SM

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/057,179 | MA ET AL. | |
| | Examiner | Art Unit | |
| | Jason M. Perilla | 2638 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *25 January 2002*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-7,11-16 and 20* is/are rejected.

7)☒ Claim(s) *8-10 and 17-19* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *25 January 2005* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

## DETAILED ACTION

1. Claims 1-20 are pending in the instant application.

### *Claim Objections*

2. Claims 1-20 are objected to because of the following informalities:

Regarding claim 1, the following version of the claim is presented by the Examiner to clarify antecedent basis of limitations in the claim:

> 1. A method for detecting symbols of a modulated signal received via channels of a wireless communications system, comprising:
>
> obtaining an initial estimate of a symbol transmitted via the channels from a previous channel estimate and a received symbol;
>
> updating the channel estimate;
>
> optimizing ~~the~~ a next estimate of the symbol transmitted which maximizes an expectation of a log likelihood function;
>
> quantizing the next estimate of the symbol transmitted;
>
> comparing the quantized next estimate of the symbol transmitted with ~~the~~ a previous estimate of the symbol transmitted to determine if the previous estimate of the symbol transmitted and the quantized next estimate of the symbol transmitted have converged; and otherwise
>
> repeating the updating, the optimizing, the quantizing, and the comparing until the previous estimate of the symbol transmitted and the next estimate of the symbol transmitted converge.

Regarding claim 2, in line 1, "the signal" should be replaced by –the modulated signal", and "MPSK" should be defined in the claim.

Regarding claim 3, in lines 2-3, both instances of "the symbol" should be replaced by –the symbol transmitted–.

Regarding claim 4, in line 2, "the symbol" should be replaced by –the symbol transmitted--.

Regarding claim 5, in line 2, "the symbol" should be replaced by –the symbol transmitted--.

Regarding claim 7, in line 1, "the symbol" should be replaced by –the symbol transmitted-- in line 2, "the signal constellation" is lacking antecedent basis.

Regarding claims 8 and 9, the variables $\hat{\Sigma}_p$, $W^H$, $X_p^H$, $\tilde{X}_{p+1}$, and $\hat{h}_p^H$ are not defined in the claim.

Regarding claim 10, in line 3, "the maximizing" is lacking antecedent basis.

Regarding claim 12, the following version of the claim is presented by the Examiner to clarify antecedent basis of limitations in the claim:

> A system for detecting symbols of a modulated signal received via a plurality of channel of a wireless communications system, comprising:
>
> means for obtaining an initial estimate of a symbol transmitted via the channels;
>
> means for updating the channel estimate;
>
> means for optimizing a next estimate of the symbol transmitted which maximizes an expectation of a log likelihood function;
>
> means for quantizing the next estimate of the symbol transmitted;
>
> means for comparing the quantized next estimate of the symbol transmitted with ~~the~~ a previous estimate of the symbol transmitted to determine if the previous estimate and the quantized next estimate have converged; and otherwise
>
> means for making the quantized next estimate of the symbol an input for a next iteration; and
>
> means for repeating the updating, the optimizing, the quantizing, and comparing until the previous estimate of the symbol transmitted and the next estimate of the symbol transmitted converge.

Regarding claim 13, in line 1, "the signal" should be replaced by –the modulated signal", and "MPSK" should be defined in the claim.

Regarding claim 14, in lines 2-3, both instances of "the symbol" should be replaced by –the symbol transmitted–.

Regarding claim 15, in line 1, "the symbol" should be replaced by –the symbol transmitted--, and, in line 2, .

Regarding claim 16, in line 1, "the symbol" should be replaced by –the symbol transmitted--, and, in line 2, "the previous symbol" is lacking antecedent basis.

Regarding claims 17 and 18, the variables $\hat{\Sigma}_p$, $W^H$, $X_p^H$, $\tilde{X}_{p+1}$, and $\hat{h}_p^H$ are not defined in the claim.

Regarding claim 19, in line 2, "the maximizing" is lacking antecedent basis.

Appropriate correction is required.

***Claim Rejections - 35 USC § 112***

3. The following is a quotation of the first paragraph of 35 U.S.C. 112:

> The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same and shall set forth the best mode contemplated by the inventor of carrying out his invention.

4. Claims 11 and 20 are rejected under 35 U.S.C. 112, first paragraph, as failing to comply with the enablement requirement. The claim(s) contains subject matter which was not described in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Regarding claim 11, the specification while related to the reception of an OFDM signal does not enable one of skill to modulate an OFDM signal. The body of the specification and the drawings to not provide any basis for the modulation of a signal

according to an OFDM modulation technique, and a modulating step is therefore not enabled by the specification.

Regarding claim 20, the claim is rejected for the same reasons as applied to claim 11 above.

***Claim Rejections - 35 USC § 103***

5. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

6. Claims 1-7, 11, 12-16, and 20 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bao et al (US 2002/0150037; hereafter "Bao").

Regarding claim 1, Bao discloses according to figure 4 a method for detecting symbols of a modulated signal received via orthogonal frequency division multiplex (OFDM; para. 0003) channels of a wireless communications system (abstract), comprising: obtaining an initial estimate (Step C; para. 0078, 0079) of a symbol transmitted via the channels from a previous channel estimate (Step A; para. 0068-0073) and a received symbol (para. 0079) ; updating the channel estimate (Step D; para. 0081-0082); optimizing the next estimate of the symbol which maximizes an expectation of a log likelihood function (para. 0046, 0047); quantizing or finding a hard decision (para. 0064) of the symbol (repeat step C); comparing the previous channel estimate with the updated channel estimate to determine if the previous estimate of the channel and the updated estimate of the channel have converged (Step E; para. 0083,

0084); and otherwise repeating the updating, the optimizing, the quantizing, and the comparing until the previous estimate of the symbol and the next estimate of the symbol converge (para. 0084). Bao discloses an iterative channel estimator wherein an initial channel estimate ($h^i$) is provided using pilot signals in step A, a received symbol $X^i$ is estimated in step C and the estimated received signal is utilized in step D to update the channel estimate ($h^{i+1}$). Thereafter, a difference between the previous and current channel estimates $h^i$ and $h^{i+1}$ is found and it is compared with a threshold in step E. If the difference is less than a threshold, the steps C to E are repeated, otherwise the estimation of the channel and the received signal has converged. Bao does not explicitly disclose that the "next estimate" and the "previous estimate" of the estimated received signal are compared. Rather, Bao discloses that the next or current channel estimate is compared with the previous channel estimate to determine if the iterations of updating the channel estimate and the corresponding update of the estimated received signal have converged. However, one skilled in the art understands that finding the difference between the "next" and "previous" channel estimates is analogous to finding the difference between the "next" and "previous" estimated received signals because both are related to the same difference in convergence.

Regarding claim 2, Bao discloses the limitations of claim 1 as applied above. Further, Bao discloses the use of various modulation techniques such as quaternary phase shift keying (QPSK). Definitively, in the art, QPSK is utilized to describe a modulation technique wherein the complex constellation of four possible received symbols all have the same magnitude and vary according to phase by 90 degrees. As

understood by one having skill in the art, any M'ary PSK constellation has symbols which only vary in phase and not magnitude. That is, they have a positive constant equivalent to an energy (magnitude) of the modulated signal. Therefore, it would have been obvious to one having ordinary skill in the art at the time which the invention was made to update only phase information of the channel estimate while communicating with a MPSK modulation technique because only the phase information is required to demodulate the received signal.

Regarding claim 3, Bao discloses the limitations of claim 1 as applied above. Further, Bao discloses subtracting the previous estimate of the channel estimate from the next estimate of the channel estimate which is equivalent to subtracting the previous estimate of the symbol from the nest estimate of the symbol as applied to claim 1 above. Bao uses the absolute value of the difference between the previous and next channel estimates compared with a predetermined threshold to determine if more iterations are required or, otherwise, if the channel estimate has converged (para. 0084).

Regarding claim 4, Bao discloses the limitations of claim 1 as applied above. Further, Bao discloses obtaining the initial estimate of the symbol from the channel estimate of a pilot symbol received via the channels (para. 0068-0073).

Regarding claim 5, Bao discloses the limitations of claim 1 as applied above. Further, Bao discloses obtaining the initial estimate of the symbol from the channel estimate of a previously received symbol (para. 0078). In the method of Bao, the initial estimate of any new symbol will be estimated according to the channel estimate of a

previously received symbol because the channel estimate is initially created according to a pilot symbol, and subsequent received symbols are obtained according to the channel estimate iteratively determined using the pilot symbol and any intermediary symbols which were received.

Regarding claim 6, Bao discloses the limitations of claim 1 as applied above. Further, Bao discloses that the optimizing or re-evaluating the symbol transmitted according to the updated channel estimate further comprises: using only a fast Fourier transform matrix, the received signal *Y(m)*, and the previous channel estimate *H(m)* (para. 0064). In the disclosure of Bao, the received signal y(m) represented as *Y(m)* is the received signal in the frequency domain (see fig. 3 for time/frequency domain conversion). Therefore, the equation in paragraph 0064 determining the value of the symbol transmitted *X(m)* must be converted to the time domain as understood by one having skill in the art.

Regarding claim 7, Bao discloses the limitations of claim 1 as applied above. Further, although Bao does not explicitly disclose that the estimate of the symbol is quantized according to the signal constellation, one skilled in the art is aware that a quantization or a hard decision is performed according to the constellation of the modulation order of the signal received. That is, during the demodulation of a QPSK symbol, for instance, four possible values are represented in the signal constellation, and the quantization or decision regarding the value of the symbol will necessarily be determined according to one of the four possible states of the constellation of a QPSK symbol. Therefore, for the utility of the receiver, as understood by one having skill in the

art, the quantization of a symbol into bits would always be determined according to the received signals modulation order constellation. Otherwise, incorrect decisions would be made.

Regarding claim 11, Bao discloses receiving orthogonal frequency division multiplex signals (OFDM; para. 0003).

Regarding claims 12-16, and 20, the limitations of the claims are disclosed by Bao as applied to claims 1-5, and 11, respectively, above.

***Allowable Subject Matter***

7. Claims 8-10 and 17-19 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

***Conclusion***

8. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. The following prior art of record not relied upon above is cited to further show the state of the art with respect to iterative channel estimation.

U.S. Pub. No. 20010004390 to Pukkila et al.

U.S. Pat. No. 6459728 to Bar-David et al.

U.S. Pat. No. 6614857 to Buehrer et al.

U.S. Pat. No. 6768713 to Siala et al.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jason M. Perilla whose telephone number is (571) 272-3055. The examiner can normally be reached on M-F 8-5 EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vanderpuye Kenneth can be reached on (571) 272-3078. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Jason M. Perilla
June 30, 2005

jmp

CHIEH M. FAN
PRIMARY EXAMINER